China's VAT reform, and Its Effects on Enterprises' Tax Burden and Innovation

Haibo Feng ,College of Economics，Jinan University, Guangzhou, China.

Sheng Liu, School of Economics and Trade, Guangdong University of Foreign Studies,

Guangzhou, China.

Fei Xu, School of Business, Economics and Statistics Umeå University, Umeå, Sweden.

Abstract：The impact of China's VAT reform on enterprise innovation is the result of the combination of tax cuts and endogenous incentives. We find evidence that China' VAT reform generally reduced the tax burden of firms but had a different impact on the manufacturing and the service industry. The tax burden of the manufacturing dropped significantly, but that of the service industry did not change markedly. Furthermore, we show that China's VAT reform had also a significant positive impact on corporate innovation for both the service industry and the manufacturing. However, these effects were significantly greater in the manufacturing. Meanwhile, China's VAT reform did not alleviate the tax burden of all the enterprises. For the enterprises facing the increased burden of tax, the reform can still stimulate the enterprise innovation if it has sufficient own capital, whereas the impact coefficient and significant level reduced significantly compared with the enterprises that the burden of tax reduced. If the enterprise's own capital is insufficient, VAT reform has little effect on enterprise innovation. Finally, we show that China's VAT reform exerted different influences on the innovative behavior of heterogeneous enterprises.
Keywords：China's VAT reform，Tax Burden，Innovation
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I. Introduction

The change of business tax to value-added tax (referred to as "China's VAT reform") is a major change in China's contemporary tax system. From January 2012 when the experiment of reform started from the specific industries in some regions until May 2016 when the reform appeared in full swing, the impact of this reform presents out gradually. The original intention of this reform is to alleviate the tax burden of enterprises and to facilitate adjustment of the economic structure and industrial upgrading through the tax reform. The tax reform has been regarded as an important tool to facilitate adjustment of the economic structure and industrial upgrading (Sun, 2016). According to the general principle of economics, adjustment of the economic structure and industrial upgrading will not be realised out of thin air. It must rely on the independent innovation of enterprises and take it as the premise. China is facing the difficult context that the economy enters a "new normal" and the external environment becomes tight, therefore, innovation is the heart of the sustainable development of China's economy. The report of the 19th National Congress of the Communist Party of China clearly stated that innovation is the primary force guiding development. Therefore, only by stimulating innovation can China's VAT reform facilitates adjustment of the economic structure

and industrial upgrading. In modern society, enterprises are a significant subject of innovation. It is an important research question to explore whether recent China's VAT reform stimulates innovation of enterprises.

The correlation between taxes and innovation has been studied from the perspective of income tax due to the fact that it is more convenient to make institutional arrangements that would be conducive to innovation through formulating income tax, such as giving pre-tax credit of the cost of innovation and levying a low tax rate on innovation income. In fact, income tax has been similarly designed in many countries around the world. It is generally accepted that tax incentive could promote innovation (Atkinson, 2007; Ernst et al., 2014; Jolley et al, 2015). Tassey argues that the tax incentives introduced by a government in order to encourage innovation would fail if other countries implement bigger preferential tax policy. While he points out conditions under which tax incentives to motivate innovation would fail in the open economy, he does not deny the overall effectiveness of tax incentives on innovation. The above conclusions are all based on the study of income tax. However, there are more than 130 countries and regions where VAT is implemented (Keen and Lockwood, 2010). Furthermore, the input tax credit of VAT provides a possibility to design an institution from which innovation could benefit. However, the research on the impact of VAT on innovation is lagged. The VAT has contributed the most to fiscal revenue since China's tax reform in 1994. On January 1, 2009, the transition from production-type VAT to consumption-type VAT fully completed in China. The VAT transition is considered to play a significant role in promoting the development of high-tech industries (Yu and Jiang, 2014), which infers that the current VAT system theoretically has genes that stimulate innovation. Before the VAT reform, the scope of VAT is manufacturing and the scope of business tax focuses on the service industry. Therefore, VAT reform is the transition of taxation of the service industry from business tax to value-added tax. This transition exerts a lot of influences which attracted a lot of attention from Chinese scholars. Before 2017, their research focuses on the following aspects: (1) the impact on enterprise tax burden (Tian and Hu, 2013; Tong et al., 2015); (2) the impact on enterprise investment behaviour (Yuan, 2015); (3) the analysis of the effects of specialization (Chen and Wang, 2016; Fan and Peng, 2017); (4) the impact on income distribution (Ge et al., 2015; Nie et al., 2016). Meanwhile, little work which especially studies VAT reform from the perspective of stimulating enterprise innovation has been published until recently. Yuan (2018) analyses the impact of VAT reform on enterprise technology innovation using the service industry as a sample and argues that VAT reform benefits enterprise innovation due to the reduction of the enterprise tax burden. Tang (2017) shows that VAT reform has significantly promoted service enterprises' investment in research and development. In Wang and Cao (2018), VAT reform significantly inhibits the willingness of service enterprises to participate in innovation. The existing literature on the impact of VAT reform on enterprise innovation mainly concentrated in the service industry without enough attention to manufacturing and the result is ambiguous, which provides the space for our further research.

The contributions of this paper are mainly reflected in three aspects: (1) While some of the recent studies have examined the correlation between the value-added tax and innovation, the mainstream taxation about innovation is limited to the study of income tax. This paper analyses the impact of China's VAT reform on innovation and extends the aspects of the study of the correlation between tax and innovation from the income tax to the commodity tax, expanding the research scope

of taxation. (2) VAT reform is a change in the taxation system that has occurred in the service industry, which seems not related to manufacturing. Therefore, most of the existing research only examines the impact of VAT reform on the tax burden of service industry whereas ignores its impact on the tax burden of manufacturing, which leads to the incomplete understanding of the impact of VAT reform on the tax burden of all industries. (3) In existing literature about the correlation between VAT reform, enterprises tax burden and innovation, VAT reform alleviates the enterprise tax burden in order to stimulate innovation. The reduction of the enterprise tax burden is viewed as the only motivation for innovation. However, we argue that the reduction of enterprise tax burden provides enterprises with the ability to participate in innovation. More importantly, the motivation for innovation attributes to the transformation of the internal incentives. The impact of China's VAT reform on enterprise innovation is the result of the combination of tax cuts and endogenous incentives.

This paper establishes the following four main results. First, China's VAT reform significantly reduced the tax burden of manufacturing whereas the reduction effect on the service industry is insignificant. Second, China's VAT reform generally reduced the tax burden of enterprises and improved their ability of innovation. More importantly, compared with business tax, VAT has a stronger impact on stimulating the intrinsic and dynamic mechanism of innovationn. The impact of China's VAT reform on corporate innovation is the result of the combination of tax cuts and endogenous incentives. Third, China's VAT reform did not alleviate the tax burden of all the enterprises. For the enterprises facing an increased burden of tax, the reform can still stimulate the enterprise innovation if the enterprise has sufficient own capital. However, if the enterprise's own capital is insufficient, VAT reform has little effect on enterprise innovation. Finally, China's VAT reform exerted different impacts on the incentives of innovation of heterogeneous enterprises.

The paper is organized as follows. Section II presents the theoretical modal and proposes a research hypothesis. Section III is the empirical design and data description. Section IV and Section V show the results of empirical analysis. Section VI concludes.

II.   Theoretical analysis and hypothesis

Maximizing profits is the main objective of the enterprise. Reducing the tax burden of the enterprises contributes to achieving this main objective. In modern society, innovation is the key element which determines the enterprise survival and development. Reducing the tax burden of the enterprises will enhance their ability to participate in innovation activities. According to this logic, the first step to study the theoretical impact of China's VAT reform on innovation is to analyze the impact of the reform on the tax burden of the enterprise and then to explore how the tax burden of the enterprises affects innovation.

1.   China's VAT reform and the tax burden of enterprises

Before the VAT reform, the incidence of taxation of the business tax covers the construction industry, transportation industry, post and telecommunications industry, culture and sports industry,

finance and insurance industry, the entertainment industry and living services industry. The taxation basis is the provision of the turnover of taxable services, the amount of the transfer of the intangible assets or the sales of the immovable property. The tax rate varies from 3% to 20% according to tax items and the tax rate at 11% was reduced to 10% in 2019. After the comprehensive experiments of VAT reform, the industries on which the business tax levied, except for small-scale taxpayers, no longer pay a full tax of the turnover or the sales. The early stage of the implementation of the reform, two different categories of the tax rate, 11% and 6%, are imposed on these industries according to different regulations of input tax deduction of different industries. The policymakers regard VAT reform as the tax cuts and require reduction of the tax burden of all industries after the reform. According to the existing institutional arrangements, although the apparent tax rate of VAT is generally higher than the tax rate of the business tax, VAT allows the deduction of tax on items purchased, while the business tax is a full tax on operating income. Therefore, if the design of the tax rate is reasonable, VAT reform could theoretically fulfil the requirement of tax cuts on the service industry in a short time.

Although the existing system design of VAT reform can theoretically achieve the requirement of reducing the tax burden of the service industry. In the actual operation process, it is very difficult to reduce the tax burden of all enterprises in the service industry. The item of expenditure of many service enterprises mainly focuses on the wages, while the proportion of the expenditure of the raw materials and fixed assets in the total expenditure is not large. Based on the existing regulation of input tax credits of VAT reform, the wages cannot be deducted from the input tax, which means that the tax burden of asset-light enterprises will increase instead. Of course, the asset-light enterprises may assemble all assets for the input tax credits at the beginning of VAT reform in order to get the tax cuts. However, in the long term, the tax burden will still increase due to the lack of raw materials and fixed assets that can be deducted from input tax. On the other hand, VAT reform will enhance the tax compliance of enterprises (Mao and Liu, 2017). The chain of VAT deduction is linked with one another. Any evasion of the tax payable at the previous stage will have been set right by the next one. Therefore, the buying and selling parties will form a mutual supervision relationship, reducing the possibility of the tax evasion so that the effective tax rate would correspondingly increase. In other words, while the tax burden of the entire service industry theoretically measured by VAT reform reduces, it does not rule out cases in which the tax paid by some enterprises does not reduce and even increases considering the characteristics of asset-light enterprises and the increased tax collection rate. Obviously, since the proportion of asset-light enterprises in the service industry is relatively large, the effect of VAT reform on tax cuts may not be significant for the entire service industry.

Although the incidence of taxation of the VAT is the service industry, the impact of VAT reform on enterprises tax burden is not limited to the service industry. Before the VAT reform, the VAT is not levied in the service industry. And commercials or services purchased by manufacturing from the service industry are not offered VAT special invoices to get the input tax credits. After the VAT reform, manufacturing is able to obtain the input tax credits on commercials or services purchased from the service industry. Therefore, VAT reform can reduce the tax burden of manufacturing. Based on the above reasoning, the first hypothesis of this paper is proposed.

Hypothesis 1: China's VAT reform may significantly reduce the tax burden of manufacturing

enterprises, but this reduction effect may not be significant for service enterprises. In general, the reform may reduce the tax burden of full sample enterprises.

2. The enterprise tax burden and innovation

It is widely believed the tax burden has a negative impact on enterprises innovation (Lin and Liu, 2017). Is it guaranteed that enterprises will increase the investment in innovation as long as the tax burden reduces? On the contrary, will increased tax burden decrease enterprises investment in innovation?

Generally speaking, if VAT reform reduces the tax burden of enterprises, the after-tax profit of enterprises will increase, which enhance the independent innovation capacity of enterprises. The crux of the matter is whether the enterprises would invest the additional profit in innovation activities. Enterprises may face two options. In one case, the additional profit stimulates enterprises to innovate using part of their own capital in order to further improve future profitability. In another case, if the enterprises believe that their existing technology could guarantee stable profits for the long term, they will not have motivations to spend the additional profit in innovation. It shows that the reduction of the tax burden of enterprises improves the innovation capacity of enterprises. However, it is not certain that enterprises will participate in innovation.

If VAT reform increases the tax burden of enterprises, the after-tax profit of enterprises will decrease, which weakens the independent innovation capacity of enterprises. Will the decline in profits necessarily lead to the reduction of enterprises innovation activities? For enterprises with relatively sufficient capital accumulation, the declines in profits will the pressure of competition, compelling these enterprises to intensify innovation activities. On one side, under the condition of declining profitability, capital accumulation provides funds for enterprises innovation activities. On the other side, it helps enterprises to break financing constraints through obtaining external support to cover the cost of innovation. However, for enterprises without sufficient capital accumulation, facing the pressure of survival caused by the decline in profits, they can neither utilize own capital to innovate nor break the financing constraints to obtain external support for innovation. Therefore, the increase in the tax burden harms innovation.

The above analysis partially explains the impact of the changes in the tax burden of enterprises on innovation. Furthermore, we raise another question. Regardless of whether VAT reform reduces the tax burden of enterprises, compared with the business tax, is the system design of VAT characterized by motivating innovation?

According to the basic principles of taxation, VAT is levied on the value of goods or services that have provided every time there is a transaction. In Marxist economics, the full value of a product consists of (V+V+M) where (V+M) is the added value, C is the consumption of material goods during the production, V is the wages, and M is the surplus value. The VAT is the levy on (V+M). After VAT reform, the VAT is levied on both the manufacturing and service industry. In order to accurately define the amount of added value, C includes both the consumption of material goods and also all kinds of service consumptions offered VAT special invoices. Different from the VAT, the business tax is levied on the full amount of the operating income (C+V+M). Therefore, the tax base of business tax is higher than the base of VAT, but the business tax rate is generally lower than the VAT rate. In the VAT system, C is exempt from tax due to the input tax credits. The exemption provides innovation incentives for enterprises. Innovation is an adventure with the cost of material

goods and knowledge, including the purchase of raw materials, machinery and equipment, instruments, intellectual capital, and various service expenditures. All of the input listed above fall within the scope of C. The larger the value C, the larger the input tax deducted, and the smaller the VAT actually paid by the enterprises. Enterprises that pay VAT will participate in innovation on their own initiative in order to reduce the tax burden. In the business system, the cost of innovation is not deductible, which means that tax is levied on the full amount of operating income (C+V+M). There is no motivation for enterprises to engage in innovation for the reduction of the tax burden. The comparison of the mechanism of taxation between VAT and business tax shows that VAT has more advantages to provide innovation incentives. The fundamental reason is that the input tax credits of VAT enables the government to share the risks of innovation with enterprises, which is missing in business tax system even the business tax rate is lower than VAT rate. The existing literature provides the evidence that offering tax deductions on enterprises consumption of fixed assets (new material capital) or the costs of research and development is more effective than reducing the tax rate to stimulate enterprises innovation.

Based on the above analysis, while Hypothesis 1 proposes that the effect of VAT reform on tax cuts to service enterprises is insufficient and therefore its impact on improving service enterprises innovation is not obvious, VAT reform may comprehensively improve the innovation of overall service industry considering that the system design of VAT is characterized by motivating innovation. The innovation capacity of manufacturing would be improved since VAT reform has a significant effect on tax cuts to manufacturing. In addition, VAT reform has inherent innovation incentives. We can infer that VAT reform has significant and positive incentives for improving manufacturing innovation. Hence, the second hypothesis is proposed.

Hypothesis 2: China's VAT reform may significantly promote the innovation of both service enterprises and manufacturing enterprises. And this positive incentive on innovation for the manufacturing may be greater than that for the service industry.

Although China's VAT reform may have the incentive effects on innovation of enterprises in general, for those enterprises that will face an increased burden of tax after the reform, their innovation activities may be constrained by their insufficient own capital due to the decline in profit level. Based on the above analysis, the third hypothesis is further proposed.

Hypothesis 3: For the enterprises facing an increased burden of tax, the VAT reform can still stimulate the enterprise innovation if the enterprise has sufficient own capital. However, if the enterprise's own capital is insufficient, the reform has little effect on enterprise innovation.

In summary, Hypothesis 1 points out the impact of the VAT reform on the tax burden of enterprises. Hypothesis 2 and Hypothesis 3 reveal the possible impact of the VAT reform on the innovative behavior of enterprises. However, it needs an empirical study to test whether the actual situation is consistent with the above hypotheses. Furthermore, this paper analyses the impact of the VAT reform on the innovative behavior of enterprises based on the enterprises' heterogeneity in enterprise ownership, technology level and the scale of business.

III.   Empirical Design and Summary Statistics

1. Institutional background

The VAT was introduced in China in 1979 and experienced two stages reformation in the following 14 years. In December 1993 the "Provisional Regulations on Value-Added Tax of the People's Republic of China" was promulgated, representing the VAT realized the indigenized transform of the levying scope and tax rate. China's turnover tax system has established a stable situation where VAT and business tax are in parallel. These two taxes are specialized in separated tasks. The VAT is levied on most of the goods and processing and repair and replacement services and the business tax is levied on most of labour service, immovable property and intangible assets. Furthermore, the two taxes are quite different in levying. The VAT is levied on the added value realized by the taxpayer or the tax unit during the producing activities. However, the business tax is based on the turnover of the taxpayer or the tax unit. It means that if the manufacturer purchases services, the business tax invoices are not deductible. The double tax will be levied on commodities and services produced by the manufacturer, which goes against the healthy and rapid development of the enterprises. In this regard, the State Council promulgated the "A Pilot Program to Replace Business Tax with Value-Added Tax", proposing the guiding ideology of establishing and improving a taxation system conducive to the development of scientific development, promoting economic restructuring, and supporting the development of modern service industry. The reform started from the "1+6" industries in the pilot regions and then was extending throughout a whole state to clear the obstacles for the healthy development of the modern service industry. As time progresses, VAT has extended throughout a whole country since the second half of 2013. Since January 2014, the nationwide railway transportation and postal industry have joined the VAT reform. The telecommunications have been included in the nationwide VAT reform. The remaining service industries implemented the transform from the business tax to VAT in May 2016.

2. Difference-in-difference model specification

The process of VAT reform provides a good basis for the adoption of difference-in-difference model (DID). There are two fundamental requirements for the application of the DID model. First, an external policy shock is required. Second, it is necessary that this shock influences some parts of the social samples, but other parts are not affected, or the impacts are very little. The VAT reform perfectly fits these two requirements. The business tax levied on some parts of the service industry transformed to VAT at some point in time. And at this point, the VAT reform happened in some pilot regions rather than on a national scale. In most of the empirical research of VAT reform, DID and difference-indifferences-in-differences (DDD) are widely used to evaluate the effects of VAT reform (Dong, 2016; Fan and Peng, 2017). The above analysis shows that the inter-industry interaction between the service industry and the manufacturing is very lively and all the upstream industry, midstream industry and downstream industry are influenced by VAT reform. Therefore, the second requirement will fail if we assume industries in which reform took place as the treatment group and other industries as the control group. It raises the issue that industries in non-pilot regions will be added into the treatment group, which may overestimate the impact of VAT reform. In addition, as shown in the above analysis, manufacturing is influenced by VAT reform. Therefore, manufacturing is not qualified to be the control group.

It is more suitable to use the pilot industries and their manufacturing in provinces and regions where the reform took place as the treatment group and use other service industries which were not pilot and all industries in provinces and regions without reforming as the control group. The reason

is that there is a cluster effect in the development of industries. Enterprises in the same region are even more closely connected (Wang and Hou, 2007). While the development of industries in different provinces or regions has a certain of interaction, the interacted activities between industries in different provinces or regions are much less than the connected activities between manufacturing industries and service industries in the same province or region. In addition, the pilot provinces and regions are basically in coastal regions. And many of them are geographically proximate and could be viewed as a whole (such as Beijing – Tianjin area, Yangtze River Delta area, etc) to minimize the deviation of the setting of DID model. For a given enterprise i in the industry j, in fiscal year t and the region k, we consider the following empirical specification：

$$Taxburden_{i,j,t,k} = \alpha_0 + \beta_1 Treat_{i,j,k} * Time_t + \beta_2 Treat_{i,j,k} + \beta_3 Time_t$$
$$+\gamma_1 X_{i,j,t,k} + \eta_i + \mu_j + \delta_t + \tau_k + \varepsilon_{i,j,t} \qquad （1）$$

$$Innovation_{i,j,t,k} = \alpha_0 + \beta_1 Treat_{i,j,k} * Time_t + \beta_2 Treat_{i,j,k} + \beta_3 Time_t$$
$$+\gamma_1 X_{i,j,t,k} + \eta_i + \mu_j + \delta_t + \tau_k + \varepsilon_{i,j,t} \qquad （2）$$

where $Taxburden$ representing the tax burden of enterprises, $Innovation$ representing the level of innovation, $Treat$ representing the provinces (regions) where reforms took place and industries reformed (including local manufacturing), $Time$ representing the exact time of implementation of VAT reform, and X representing other control variables influencing the tax burden and the level of innovation of enterprises. η_i represents individual effects. μ_j represents industry effects. δ_t represents time effects and τ_k represents regional effects. And $\varepsilon_{i,j,t}$ represents residuals. For the two dummy variables representing VAT reform, we define that $Treat$e equals 1 if the enterprise is in the pilot service industry and in the province where the reform took place, otherwise it equals 0. The value of $Time$ needs more explanations. While the 9 pilot provinces started reforming from 2012, Shanghai is the only region where the reform took place in January 2012 and the other regions actually started from the second half of the year. The effects of the refom may not be obvious in 2012 (Chen and Wang, 2016). Therefore, the reform timing of Shanghai is set to be in 2012. For other regions, the reform timing is set to be 2013. The dummy variable $Time$ equals 1 for the year of the implementation of VAT reform and afterwards, and 0 for the year before that.

3. Variable and descriptive statistics

1) Dependent variable

Taxburden: two types of enterprise tax burden measures have been exploited in the literature. The first one is the rate of tax to operating income and the second set of variables is the rate of tax to net profit (Wu, 2009; Liu and Li, 2012; Liu and Liu 2014; Cao and Li, 2016). These two measures have little statistical difference. But from the enterprise actual burden point of view, the latter one plays a better role in measuring the enterprise tax burden. The operating income is a summary of the enterprise business scale, whereas the net profit reflects the profitability and future development of enterprises. Therefore, the rate of tax to net profit is more appropriate to measure the enterprise tax.

We use the enterprise tax burden as the dependent variable. Considering that the financial statements of listed companies only record three categories: business tax and surcharges, income tax expenses and taxes payable, it requires further calculation in order to get the turnover tax (value-

added tax and business tax) which is the target of our analysis. The total tax burden is the sum of the turnover tax and the income tax. The income tax burden is calculated in a more uniform manner. The income tax burden = (income tax expenses – deferred income taxes) / net profit. There are large differences in the calculation of the turnover tax. The existing estimation methods are generally based on the cash flow for the year (Wang, 2014; Liu and Liu, 2014). However, some scholars point out that the turnover tax also concerns about the same issue of deferral as the income tax. In other words, the turnover tax that should have been paid in the current year may be actually paid in the next year due to the issue of tax deferral, introducing bias into the calculation based on the data of the current year (Cao and Li, 2016).　Therefore, in the line of the research of Tong et al. (2015), and Cao and Li (2016), we adopt the following method to calculate the turnover tax burden: (1) if there is a single additional charges of the educational expense, the educational expense is directly divided by 3%; (2) if the additional charges of educational expense are calculated by multiple expense rates, the local additional charges of educational expense is divided by 2%; (3) if both the additional charges of the educational expense and the local additional charges of educational expense are calculated by multiple expense rates, urban maintenance and construction tax is divided by the corresponding single tax rate; (4) if all three of the above are calculated by the multiple expense rates, the educational surtax is used; (5) the turnover tax burden equals the calculated turnover tax divided by the net profit and the sum of the turnover tax burden and the ratio of income tax to the net profit is the overall enterprise tax burden.

Innovation: two types of innovation measures have been exploited in the literature, the enterprise' investment in research and development (R&D) and the number of applications for patents (Greunz, 2004; Wang and Tsai, 2009; Cai, et al.，2017). Being limited by the availability, our empirical study adopts the R&D as the variable of innovation measure.

2) Control variables

Based on the empirical evidence, the tax burden and innovation activities of enterprises are influenced by the following categories of company-level control variables (Stickney and Mc Gee, 1982；Spooner, 1986；Wu, 2009；Liu and Li, 2012；Li et al., 2013；Dong et al., 2014): (1) enterprise asset scale, Lcapital, which is defined as the logarithm of enterprise total assets and expected to have a negative impact on the enterprise tax burden and a positive impact on innovation; (2) financial leverage, Lev, which is measured by the ratio of total liabilities to total assets and is expected to have a positive impact on the tax burden and a negative impact on innovation; (3) the density of inventory, Hasset, which is defined as the ratio of net inventories to total assets and expected to have a positive impact on tax burden and a negative impact on innovation; (4) the intensity of tangible assets PPE which is measured by the ratio of net fixed assets to total assets, and the intensity of intangible assets Intang, which is measured by the ratio of net intangible assets to total assets, and both are expected to have a negative impact on the tax burden and a positive impact on innovation; (5) investment gains, Eqinc, which is defined as the ratio of investment gains to total assets and expected to have a negative impact on tax burden and a positive impact on innovation; (6) price earing ration, ROA, which is measured by the ratio of net profit to total assets and expected to have a negative impact on tax burden and a positive impact on innovation; (7) enterprise business scale, Loperation, which is defined as the logarithm of enterprise operating revenue and expected to have an ambiguous impact on tax burden and a positive impact on innovation; (8) market competitiveness of products, Sfin, which is defined as the ratio of annual selling expenses to

operating revenue and expected to have an ambiguous impact on tax burden and a negative impact on innovation; (9) the growth of enterprises, Tobin Q value, which is defined as the ratio of total market value of listed companies to total assets and expected to have a negative impact on tax burden and a positive impact on innovation; (10) previous period loss, Loss, which equals to 1 if the net profit for the previous period is negative and 0 otherwise. The loss for the previous period could be used to offset the payable tax for the current period, therefore it is expected to have a positive impact on tax burden and a negative impact on innovation.

4. Data sources and descriptive statistics

We focus on the listed companies of the Shanghai Stock Exchange and Shenzhen Stock Exchange. According to the definition of variables and the availability, we use the CSMAR and Wind datasets for the period 2004 – 2016. The division of industry is based on the National Economic Industrial Classification issued by the statistical bureau. The definition and source of the variables are shown in Table 1:

Table 1: Variable definitions and sources

Variable	Definition	Sources
Taxburden	Enterprise tax burden: (tax paid-tax refunds received) / net profit	CSMAR
Innovation	Innovation level: Enterprise research & development expenses / operating revenue	Wind
Lcaptial	Enterprise asset scale: logarithm of enterprise total assets	CSMAR
Loperation	Enterprise business scale: logarithm of enterprise operating revenue	CSMAR
Lev	Financial leverage: total liabilities / total assets	CSMAR
Hasset	The density of inventory: net inventories / total assets	CSMAR
PPE	The intensity of tangible assets: net fixed assets / total assets	CSMAR
Intang	The intensity of intangible assets: net intangible assets / total assets	CSMAR
Eqinc	Investment gains: investment gains / total assets	CSMAR
ROA	Price earnings ratio: net profit / total assets	CSMAR
Sfin	Market competitiveness of the products: annual selling expenses / operating revenue	CSMAR
Q-value	The growth of enterprise: total market value of listed companies / total assets	CSMAR
Loss	Previous period loss: 1, if the net profit for the previous period is negative; 0, otherwise.	CSMAR

According to the reasonability, we drop ST firms, firms characterized by negative revenue and non-positive proportion tangible assets and also firms characterized by negative payment. Removing these abnormal values contributes to the robustness of our results. Our final sample consists of 3111 unbalanced firm-level panel data. The descriptive statistics of variables is shown in Table 2:

Table 2: Descriptive statistics

Variable	Unit	Mean	Standard error	Minimum	Maximum
Taxburden	%	1.13	2.52	-12.10	19.62
Innovation	%	0.12	0.20	0.02	0.83
Lcaptial	-	21.74	1.36	18.81	26.71
Loperation	-	21.18	1.53	16.70	25.41
Lev	%	0.51	1.84	-0.19	142.72
Hasset	%	0.17	0.16	0.00	0.94
PPE	%	0.24	0.18	0.00	0.97
Intang	%	0.04	0.06	0.00	0.90
Eqinc	%	0.01	0.03	-0.15	0.18
ROA	%	0.14	0.27	-1.13	2.01
Sfin	%	5.81	5.41	0.00	19.45
Q-value	%	1.88	1.43	0.61	6.31
Loss	-	0.02	0.15	0.00	1.00

Table 3 lists the correlation coefficients between the main variables of the equation (1). Owing to space constraints, the coefficients between variables of other equations are not reported here. We find that the correlation between control variables is basically less than 0.5, and the correlation coefficients between most of the control variables and two dependent variables, the tax burden (*Taxburden*) and innovation (*Innovation*), are significant at 5%. To a certain extent, it shows that the selected control variables satisfies internal validity and there is no serious multicollinearity between the variables.

Table 3: Correlation matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Taxburden	1.00	-0.01	0.28	0.24	0.14	0.02	-0.06	0.14	**-0.65**	**-0.06**	-0.25	0.00
Lcaptial	-0.06	1.00	0.68	0.41	0.10	0.03	-0.05	0.10	0.08	-0.20	-0.51	-0.01
Loperation	0.14	0.71	1.00	0.36	0.13	0.11	-0.03	0.19	**-0.40**	-0.17	-0.39	-0.04
Lev	0.16	0.43	0.37	1.00	0.30	0.06	-0.09	0.02	-0.32	-0.23	-0.56	0.07
Hasset	0.13	0.10	0.07	0.31	1.00	-0.32	-0.16	-0.04	-0.17	0.05	-0.18	**0.01**
PPE	0.03	0.01	0.09	0.05	-0.34	1.00	0.22	-0.04	-0.17	-0.12	-0.14	0.02
Intang	**-0.01**	-0.06	-0.08	-0.04	-0.20	0.09	1.00	-0.03	-0.00	0.11	0.10	**0.01**
Eqinc	0.19	-0.04	0.06	**0.01**	-0.04	-0.05	-0.03	1.00	-0.09	**-0.01**	-0.06	-0.01
ROA	-0.18	0.09	-0.35	-0.06	-0.02	-0.12	0.02	-0.00	1.00	0.09	0.30	-0.03
Sfin	-0.00	**-0.20**	-0.12	-0.15	-0.02	-0.07	0.02	0.05	-0.00	1.00	0.24	-0.03
Q-value	-0.13	-0.46	-0.41	-0.48	-0.19	-0.17	0.04	-0.03	0.15	0.04	1.00	-0.02
Loss	0.03	-0.03	-0.05	0.07	0.02	0.02	0.02	0.02	0.03	-0.02	**0.01**	1.00

Note: The upper part of the table represents the Spearman correlation coefficients and the lower part of the table shows the Pearson correlation coefficients. The bolded values show that the confidence level of correlation coefficient is lower than 5%, and the rest indicates that the correlation is statistically significant at 1%.

IV. China's VAT reform tax cut effect and innovation effect

1. The effect of China's VAT reform on tax cut

We control time fixed effects, regional fixed effects, and industry fixed effects and adopt clustered standard error at the firm level in order to reduce the error. The results are shown in Table 4. According to the above analysis, the proportion of the consumption of fixed assets and raw materials to service enterprises' expenditures is relatively small, while the labour costs such as wages which is not deductible from the input tax are the bulk of enterprise expenditure. Suppose a service enterprise on which the rate of enterprise tax levied increased from 3% to 11% (the VAT of service enterprises at the beginning of VAT reform), it will have to pay higher tax unless its input tax accounts for 8% of the total operating income. It could be seen that it is not an easily achievable target to reduce enterprise tax burden through VAT reform, especially for enterprises with a high proportion of human capital. This means that whether an enterprise tax reduces after VAT reform depends on whether the enterprise could obtain enough input tax credits. The situation is different for manufacturing. The manufacturing had always implemented the VAT before VAT reform. After that, in addition to the input tax credits of standard fixed assets and raw materials, the original purchase service that was not deductible can also be deducted by VAT special invoice so that enterprise tax burden declines. The columns (1) and (2) in Table 4 respectively represent the regression results of samples of the service industry and of the manufacturing. The VAT reform coefficient of service industry is negative but insignificant, which verifies the research of Fan and Peng (2017) and Dong (2016) but completely differs from those of Yuan et al. (2018) and Hong (2015). In Yuan et al. (2018), VAT reform significantly reduces the tax burden of the service enterprises whereas, in Hong, VAT reform significantly increases their tax burden. The manufacturing coefficient is -0.1733 and significant at 1% confidence level, indicating that VAT reform significantly reduced the tad burden of manufacturing. None of the existing literature provides a special study on the impact of VAT reform on the tax burden of manufacturing. Hence, Hypothesis 1 is proved.

Furthermore, we conduct a quantitative test on the whole population in order to explore the overall effects of tax cuts. The column (3) shows the results that the overall effects of tax cuts induced by VAT reform are significant negative. The implementation of the policy reduced the tax burden of the whole population by 0.2110%.

An important premise of the difference-in-difference model is that the treatment group and the control group have the same trends. The estimation would be higher if the trends are different. Therefore, this paper adopts two methods for robustness testing. We first assume the linear time trend and then introduce the multiple of the province fixed effects, industry fixed effects and time fixed effects in order to examine the common trend assumption (Angrist and Pischke, 2015). The significance of this method is that if the intersection of regions, industries and time represents a common time trend existed in clusters of enterprises classified by industries, the conclusion that the policy changes affect the development of the pilot enterprises is supposed to be consistent with the estimation of the previous regression discussed in details above. Without this common time trend, the impact of policy changes on the treatment group would show a relatively large bias. In other words, the impact of VAT reform on tax cuts would greatly deviate from the conclusion of the previous method.

Table 4: The effect of China's VAT reform on the burden of the corporate tax

Variable	Dependent variable: the burden of the corporate tax				
	Service industry	Manufacturing	Total sample	Total sample	Total sample
	（1）	（2）	（3）	（4）	（5）
Treat*Time	-0.1086	-0.1733**	-0.2110***	-0.2083**	-0.1081
	(0.2165)	(0.0841)	(0.0819)	(0.0865)	(0.1008)
Time	0.1644	0.4023	0.2842	0.3311	-0.3340**
	(0.2832)	(0.2904)	(0.1940)	(0.2277)	(0.1382)
Treat	-0.4632	-0.6427	-0.6135*	-0.6309	-0.5561
	(0.6635)	(0.4183)	(0.3686)	(0.3974)	(0.4179)
Lcaptial	-1.0843***	-0.9705***	-0.9334***	-0.9468***	-1.0461***
	(0.1286)	(0.0793)	(0.0669)	(0.0679)	(0.0805)
Loperation	0.7528***	0.7429***	0.6899***	0.6988***	0.7620***
	(0.1085)	(0.0622)	(0.0543)	(0.0549)	(0.0633)
Lev	1.2430***	1.1532***	1.1169***	1.1053***	1.0099***
	(0.4064)	(0.1983)	(0.1741)	(0.1773)	(0.2113)
Hasset	0.6748	0.0221	0.4840	0.4695	0.6954*
	(0.4635)	(0.4151)	(0.2944)	(0.2972)	(0.3980)
PPE	1.1795***	0.3097	0.5629***	0.5726***	0.5813**
	(0.4151)	(0.2276)	(0.2000)	(0.2058)	(0.2564)
Intang	0.6548	2.6313***	1.8636***	1.9787***	2.2150***
	(0.8154)	(0.7693)	(0.5292)	(0.5421)	(0.6801)
Eqinc	7.3847***	9.4146***	9.0135***	8.9111***	8.0943***
	(2.2254)	(1.7480)	(1.3869)	(1.4098)	(1.5781)
ROA	-0.3329	-0.0037	-0.2086*	-0.2143*	-0.2514*
	(0.2178)	(0.1400)	(0.1198)	(0.1208)	(0.1453)
Sfin	0.0007	-0.0081	-0.0044	-0.0047	-0.0056
	(0.0091)	(0.0070)	(0.0050)	(0.0051)	(0.0066)
Q-value	-0.1561***	-0.1567***	-0.1179***	-0.1197***	-0.1466***
	(0.0537)	(0.0260)	(0.0233)	(0.0235)	(0.0296)
Loss	-0.0547	0.2050	0.1662	0.1642	0.1047
	(0.2105)	(0.1333)	(0.1136)	(0.1153)	(0.1349)
Cons	8.8377***	6.1024***	6.3879***	6.5366***	7.1968***
	(1.3123)	(0.8327)	(0.7030)	(0.7238)	(0.8568)
Time fixed effects	Yes	Yes	Yes	Yes	Yes
District fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
District*time*industry	No	No	No	Yes	Yes
R^2	0.220	0.168	0.182	0.189	0.192
N	4539	11884	16423	16423	11145

As shown in column (4), the coefficient of VAT reform remains about the same, indicating that the tax cut is not the result of other different trends. Therefore, the result is robust. The second method is to use the hypothesis test to examine whether the treatment group and the control group have the same trend (Zhang and Bi, 2013). The time trend will naturally appear in the model with enough control variables. But it is impossible to control all variables influencing the result in reality. The solution is to assume that the treatment group and the control group are indeed consistent before the implementation of the new policy. There will not be significant differences between the treatment group and the control group if VAT reform happened a few years before. We assume that VAT reform occurred in 2011. Time equals 1 if the year is 2011 and 2012 and 0 for other years before 2011 with other variables controlled in the same way (considering that the reform in Shanghai occurred in 2012, we remove Shanghai from the sample of this regression for simplification). The result is shown in the column (5) that the coefficient is insignificant. It verifies that the treatment group and the control group have the same time trend before the reform.

2. The effect of China's tax reform on innovation

Based on our theoretical analysis, VAT is the tax on the added value of the products and business tax is the tax on the operating income. The difference between the two is whether the input tax is deductible. The deductible input tax includes the costs of raw material, machinery and equipment, intellectual capital, and various service expenditures, which are essential inputs for the process of innovation. The higher the degree of enterprise innovation, the greater the proportion of the increase in the added-value of output. However, the high degree of innovation necessarily brings a high demand for physical capital and intangible services. Innovation has always been an adventure involving a lot of uncontrollable factors. Not every innovation investment manages to obtain enough returns (Domar and Musgrave, 1944; Feng and Liu, 2017). In the case of business tax levied, if the innovation is successful, the profits generated by innovation could usually be enough to cover its costs. However, if enterprises fail in its innovation investment, in addition to the loss of the potential profits, enterprises are not able to claim the tax deduction on the costs invested. Considering the mechanism of business tax, enterprises are more prone to reduce the innovation investment to avoid the risks of failure. Therefore, business tax does not encourage innovation. On the contrary, VAT promotes innovation for the reason that most of the costs of innovation are deductible except for the wages and the government shares the risks of innovation with enterprises.

Next, we test the above inference by empirical analysis. Table 5 shows the impact of VAT reform on enterprise innovation. Columns (1) and (2) respectively represent the regression results of service industry and manufacturing, showing that the coefficients of both industries are significantly positive and the effects of innovation incentives for the manufacturing are bigger than that for the service industry. This conclusion is in line with reality. In actual social activities, the technological innovation of manufacturing has always been in the main position, and innovation activities of the service industry are relatively less. Thus, Hypothesis 2 is proved. Furthermore, Column (3) shows the results of the whole population that the coefficient is 0.029 and it is significant

at the 1% confidence level, which demonstrates that VAT reform promotes enterprise innovation as a whole.

However, it is worth noting that VAT reform is proved to reduce the enterprise tax burden as a whole, which indicates the increase in the profits of enterprises and the improvement of the ability of enterprises to innovate. Hence, does the increase in the profits due to the decline in tax burden give rise to innovation? Or does VAT reform provide inherent innovation incentives? The specific design is as follows: (1) we judge whether enterprise tax burden increases or not from weather the enterprise overall tax burden has increased for two consecutive years; (2) and we calculate the average research and development investment of each industry in the previous year according to the national industry code and then compare the undistributed profit of the enterprise for the previous year with the average research and development investment of the industry. We define enterprises with bigger undistributed profit as the one with sufficient own funds. If the undistributed profit of enterprises is smaller, we consider them as enterprises with insufficient own funds. We then re-examine the impact of VAT reform on enterprise innovation with distinguished groups of enterprises. The results are listed in the columns (5) and (6) of Table 5.

Table 5: The effect of China's tax reform on innovation

Variable	Dependent variable：innovation				
	Service industry	Manufacturing	Total sample	Sufficient fund	Insufficient fund
	(1)	(2)	（3）	(5)	(6)
Treat*Time	0.0191**	0.0466***	0.0290***	0.0224*	0.0013
	(0.0082)	(0.0099)	(0.0085)	(0.0122)	(0.0328)
Time	-0.0184*	-0.0130	-0.0300*	-0.0431*	0.0291
	(0.0094)	(0.0259)	(0.0179)	(0.0238)	(0.0911)
Treat	0.0290*	0.0064	0.0176	0.0017	-0.0065
	(0.0153)	(0.0195)	(0.0170)	(0.0267)	(0.0277)
Lcaptial	0.0022	0.0192***	0.0120***	0.0117**	0.0176**
	(0.0034)	(0.0038)	(0.0030)	(0.0052)	(0.0087)
Loperation	-0.0112***	-0.0240***	-0.0193***	-0.0270***	-0.0030
	(0.0021)	(0.0025)	(0.0019)	(0.0038)	(0.0042)
Lev	-0.0166	-0.0615***	-0.0534***	-0.0041	0.0139
	(0.0133)	(0.0143)	(0.0115)	(0.0215)	(0.0266)
Hasset	-0.0249**	0.0107	-0.0329**	-0.0567**	0.0210
	(0.0124)	(0.0254)	(0.0163)	(0.0260)	(0.0427)
PPE	-0.0019	0.0564***	0.0514***	0.0095	-0.0449
	(0.0143)	(0.0177)	(0.0137)	(0.0215)	(0.0401)
Intang	-0.0272	0.0121	0.0394	0.0510	0.0063
	(0.0348)	(0.0438)	(0.0337)	(0.0573)	(0.0721)
Eqinc	-0.1226***	-0.2507***	-0.1961***	0.0072	-0.0111
	(0.0402)	(0.0507)	(0.0379)	(0.0171)	(0.1100)
ROA	-0.0084	-0.0386***	-0.0334***	-0.0946***	-0.0310**
	(0.0062)	(0.0103)	(0.0064)	(0.0182)	(0.0133)
Sfin	0.0010*	0.0010*	0.0008*	0.0009	0.0000

	(0.0005)	(0.0005)	(0.0004)	(0.0007)	(0.0010)
Q-value	0.0004	-0.0081***	-0.0052***	-0.0029	-0.0050
	(0.0024)	(0.0020)	(0.0017)	(0.0029)	(0.0053)
Loss	0.0026	-0.0078	-0.0070	-0.0014	0.0098
	(0.0054)	(0.0069)	(0.0054)	(0.0102)	(0.0150)
Cons	0.5876***	0.1092	0.1734***	0.5977***	-0.2558
	(0.0656)	(0.0695)	(0.0571)	(0.0908)	(0.2254)
Time fixed effects	Yes	Yes	Yes	Yes	Yes
District fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
District*time*industry	Yes	Yes	Yes	Yes	Yes
R^2	0.157	0.312	0.240	0.273	0.269
N	4299	10152	14451	4864	502

（1） If the enterprise tax burden increases, the impact of VAT reform on innovation is still significant positive when the enterprise has sufficient own capital. But the coefficient is significantly smaller, and the significance reduces. It shows that the increased tax burden due to VAT reform reduces the profit of some enterprises. The decline in profit damages innovation. Profiting from the enterprises' sufficient own capital, VAT reform still induces the effect of innovation incentive. (2) If the enterprise tax burden increases, the impact of VAT reform on innovation is positive but insignificant when the enterprise has insufficient own capital. It shows that adequate profit of enterprises plays an important role in stimulating innovation activities. In addition, it provides empirical evidence of the incentive mechanism of VAT on enterprise innovation activities. Otherwise, if the enterprise tax burden increases, VAT reform should have a negative impact on the innovation activities when the enterprise does not have sufficient own capital. Thus, Hypothesis 3 is proved.

V. Extended analysis based on enterprise heterogeneity

According to the theoretical analysis mentioned above, China's VAT reform naturally has the infernal impetus mechanism to stimulate innovation. In other words, the enterprise which benefits from the reduced tax burden will enhance its ability of research and innovation. Therefore, in general, all enterprises with reduced tax burden will be motivated by the reform to participate in innovation. Under this premise, the incentive effect of China's VAT reform on heterogeneous enterprises' innovation activity is not observable. On the contrary, the innovation ability of enterprises that tax burden increased will be weakened. The impact of China's VAT reform on innovation activity of those enterprises is inconclusive. Considering the above analysis, the following discussions about the heterogeneity in enterprises' characteristics are based on the condition that the tax burden of enterprises increased.

1. The impact of China's VAT reform on the innovation of enterprises with heterogeneous property rights

State-owned enterprises and private enterprises have completely different motivations for tax avoidance. For state-owned enterprises, the government is both the owner of the property and the collector and manager of tax as well. The government can levy the enterprises by political power and divide the after-tax profits of enterprises by its ownership. From the pure perspective of interests, there is not much difference between paying taxes and turning over the profits to the state. Therefore, compared to private enterprises, state-owned enterprises have fewer motivations for tax avoidance (Wang, et al., 2010). VAT reform has impacts on the tax burden of all enterprises. But considering that enterprises of different property rights do not respond to the tax burden, in the same way, we then explore how the state-owned enterprises and the private enterprises will perform under the condition of innovation incentives induced by VAT reform. We construct the interaction term between VAT reform and enterprises of different property rights, in order to observe the innovation performance of the private enterprises, central and local state-owned enterprises during the period of VAT reform. Following the similar structure as the above analysis, we focus on the case in which the tax burden of enterprises increases and examine innovation performance of enterprises with different property rights under conditions of with and without sufficient own funds.

In Table 7, Soe1-Soe3 are dummy variables representing the private enterprises, central state-owned enterprises and local state-owned enterprises, respectively. The results show that when enterprises have sufficient own funds and the tax burden increases, the innovation incentive of VAT reform on the private enterprises is significantly bigger than that on the state-owned enterprises. When enterprises have insufficient own funds, the innovation incentive of VAT reform on the private enterprises is insignificant smaller than that on the state-owned enterprises. It indicates that the innovation motivation of private enterprises is higher than that of state-owned enterprises. In addition, it infers that compared to the state-owned enterprises, the private enterprises face stronger budget constraints and are more difficult to obtain external financing support in case of insufficient funds. Even if private enterprises have motivations for innovation, their innovation activities are severely restricted by insufficient funds. The reason that the state-owned enterprises are grouped into central state-owned enterprises and local state-owned enterprises is because the objective functions of these two types of enterprises are totally different under the background of fiscal decentralization which leads to distinct choices made by them. For central state-owned enterprises, when the tax burden increases and enterprises have enough funds, the impact of VAT reform on their innovation is insignificantly smaller than that on the combination of private enterprises and local state-owned enterprises. Distinguishing the private enterprises from the local state-owned enterprises, we get the results that the impact of VAT reform on innovation motivations for central state-owned enterprises is smaller than that for the private enterprises but bigger than the local state-owned enterprises. When enterprises do not have sufficient funds, the impact of VAT reform on innovation incentives for central state-owned enterprises is insignificantly smaller than that for the combination of other two types. Distinguishing the private enterprises from the local state-owned enterprises, the impact of VAT reform on innovation incentives for central state-owned companies is larger than that for the private enterprises and smaller than that for the local state-owned enterprises. For local state-owned enterprises, when the tax burden increases and enterprises have sufficient own funds, the impact of VAT reform on innovation incentives is significantly smaller than that for other two types of enterprises (regardless of combined or separate). When enterprises

do not have sufficient own funds, the impact of VAT reform on innovation incentives for the local state-owned enterprises is insignificantly larger than that for other two types (regardless of combined or separate). Under the condition of sufficient funds, both central state-owned enterprises, local state-owned enterprises, and private enterprises are capable of innovating, but the magnitudes of their motivations for innovation are different. Since the private enterprises face the most serious survival crisis, the VAT reform has strongest impact on innovation incentives for private enterprises. The central state-owned companies also have strong motivations for innovation in order to fulfil the tasks of national development strategy and accomplishing their missions entrusted by the state. The local state-owned enterprises have motivations for innovation to satisfy the demand of local governments revenues. Therefore, when enterprises have sufficient own funds and VAT reform provides motivations for innovation, private enterprises would participate in innovation as much as possible. And central state-owned enterprises would increase the investments in innovation. While local state-owned enterprises would increase their innovation activities, the fact that they have sufficient funds shows that they are able to satisfy the local government's demands for revenues. Consequently, innovation activities of local state-owned enterprises are less than central state-owned enterprises and private enterprises as well. In this case, VAT reform has strongest impact on innovation incentives for private enterprises. And its impacts for central state-owned enterprises and local state-owned enterprises rank second and third respectively. If enterprises do not have enough own funds, private enterprises are not able to innovate. Compared to private enterprises, it is relatively easier for central state-owned enterprises to obtain the external funding for innovation. In addition, the innovation activities of central state-owned enterprises face less restrictions. If local state-owned enterprises do not have sufficient funds, they fail to satisfy the government's demand for revenues. They may be strongly motivated by the local government's pressure to pass the performance evaluation. Meanwhile, the local government would try to help enterprises to attract the external funding for innovation. Conclusively, when enterprises do not have enough own funds, VAT reform has strongest impact on innovation incentives for local state-owned enterprises. And its impacts for central state-owned enterprises and private enterprises rank second and third respectively.

Table 6: The impact of China's VAT reform on innovation of enterprises with heterogenous property rights

	(1)	(2)	(3)	(4)	(5)	(6)
	Sufficient fund	Insufficient fund	Sufficient fund	Insufficient fund	Sufficient fund	Insufficient fund
	Innovation	*Innovation*	*Innovation*	*Innovation*	*Innovation*	*Innovation*
*Treat*Time*Soe1*	0.0315**	-0.0611				
	(0.0139)	(0.0464)				
Soe1	0.0019	-0.0229*				
	(0.0074)	(0.0120)				
*Treat*Time*Soe2*			-0.0094	-0.0352		
			(0.0204)	(0.0347)		
Soe2			0.0115	0.0108		
			(0.0088)	(0.0201)		
*Treat*Time*Soe3*					-0.0317**	0.0716
					(0.0152)	(0.0495)

Soe3					-0.0082	0.0170
					(0.0070)	(0.0121)
Treat*Time	0.0030	0.0293	0.0226*	0.0049	0.0306**	-0.0350
	(0.0153)	(0.0499)	(0.0124)	(0.0333)	(0.0127)	(0.0264)
Time	-0.0401*	0.0036	-0.0435*	0.0263	-0.0399*	-0.0020
	(0.0240)	(0.0981)	(0.0238)	(0.0916)	(0.0240)	(0.0993)
Treat	0.0046	-0.0139	0.0053	-0.0059	0.0062	-0.0142
	(0.0266)	(0.0320)	(0.0267)	(0.0281)	(0.0270)	(0.0299)
Lcaptial	0.0098*	0.0153*	0.0089*	0.0172**	0.0096*	0.0159*
	(0.0052)	(0.0087)	(0.0052)	(0.0087)	(0.0052)	(0.0087)
Loperation	-0.0244***	-0.0036	-0.0250***	-0.0035	-0.0245***	-0.0030
	(0.0038)	(0.0043)	(0.0038)	(0.0043)	(0.0038)	(0.0043)
Lev	-0.0022	0.0131	-0.0027	0.0141	-0.0018	0.0131
	(0.0215)	(0.0260)	(0.0215)	(0.0267)	(0.0215)	(0.0260)
Hasset	-0.0602**	0.0254	-0.0609**	0.0212	-0.0603**	0.0290
	(0.0260)	(0.0422)	(0.0260)	(0.0417)	(0.0259)	(0.0418)
PPE	0.0057	-0.0452	0.0043	-0.0455	0.0057	-0.0447
	(0.0216)	(0.0390)	(0.0216)	(0.0403)	(0.0215)	(0.0389)
Intang	0.0445	-0.0009	0.0512	0.0068	0.0470	0.0019
	(0.0569)	(0.0716)	(0.0573)	(0.0719)	(0.0569)	(0.0727)
Eqinc	-0.2208***	-0.0383	-0.2240***	-0.0081	-0.2190***	-0.0363
	(0.0661)	(0.1089)	(0.0665)	(0.1097)	(0.0662)	(0.1076)
ROA	-0.0880***	-0.0272**	-0.0894***	-0.0317**	-0.0881***	-0.0275**
	(0.0185)	(0.0128)	(0.0186)	(0.0134)	(0.0184)	(0.0127)
Sfin	0.0010	-0.0000	0.0011	0.0000	0.0010	0.0001
	(0.0007)	(0.0010)	(0.0007)	(0.0010)	(0.0007)	(0.0010)
Q-value	-0.0039	-0.0037	-0.0034	-0.0055	-0.0040	-0.0035
	(0.0029)	(0.0052)	(0.0029)	(0.0054)	(0.0029)	(0.0052)
Loss	-0.0007	0.0071	-0.0011	0.0091	-0.0007	0.0079
	(0.0102)	(0.0149)	(0.0102)	(0.0152)	(0.0102)	(0.0148)
Cons	0.0000	-0.1570	0.6162***	-0.2357	0.5911***	-0.1956
	(0.0000)	(0.2338)	(0.0911)	(0.2300)	(0.0906)	(0.2307)
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
District fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
District*time*District	Yes	Yes	Yes	Yes	Yes	Yes
R²	0.7410	0.2658	0.2731	0.2690	0.2741	02648
N	4864	502	4864	502	4864	502

2. The impact of China's VAT reform on innovation of enterprises with heterogenous scales

The study of the relationship between the business scale and innovation can be traced back to

Adam Smith's work in the division of labour. It refers to the evolution from conventional separate production to the unified division of labour and cooperation, which could be understood as the institutional innovation. In Schumpeter's (1942) innovation theory, the larger the enterprise size, the more concentrated the resource endowment, and the soil that fosters innovation is more mature. Generally speaking, large enterprises have more advantages in terms of economies of scale, capital flow, and financing capabilities, compared with small enterprises. Therefore, the motivation of large enterprises for innovation usually lasts longer. However, in more contemporary terms, scholars regard enterprise-scale as a control variable influencing innovation without considering how VAT reform influences innovation of enterprises of different scales (Jiang and Feng, 2000; Nie et al., 2008; Bai, 2011). Therefore, this paper introduces the enterprise scales as a variable to examine the impact of VAT reform on innovation. Since this paper uses data of listed companies, if enterprises are clarified by the operating income, all enterprises targeted are big enterprises without further clarification of different sizes. This paper examines the impact of enterprise-scale on innovation through comparing the interaction effect of VAT on enterprises in the top 5% of operating income and the effect on enterprises in the bottom 5% of operating income. We define the dummy variable of enterprise-scale Size1 as 1 if the enterprise is in the top 5% of its industry and as 0 otherwise. The dummy variable Size2 equals 1 if the enterprise is in the bottom 5% of its industry and as 0 otherwise. Under the condition that the enterprise tax burden increases, we analyze enterprises with and without sufficient own funds respectively. The results are shown in Table 6. The results of the enterprises in the top 5% are listed in column (1) and (2) and the results of the enterprises in the bottom 5% are listed in columns (3) and (4).

The coefficient of enterprises in the top 5% of enterprise-scale is positive but insignificant if the enterprises have enough own funds. However, the coefficient of enterprises in the bottom 5% of enterprises scale is insignificant negative. It shows that if the emprises have enough own funds, big enterprises are more capable of organizing innovation activities than small enterprises and VAT reform does not have significantly different impacts on innovation incentives of different sizes of enterprises. However, if the emprises do not have enough own funds, both sizes of enterprises show significant negative effects, but VAT reform have a more negative influence on small enterprises. In other words, under conditions of the increased enterprises tax burden and insufficient own funds, the VAT reform does not benefit the innovation of enterprises either in the top or in the bottom of industries. For enterprises in the top 5%, the top of the pyramid, VAT reform has certain incentives to increase enterprises investments in innovation, but the increases in investments will undoubtedly expand the enterprises scale, which would lead to diseconomies of scale. Under the condition of insufficient own funds, diseconomies of scale may even from a stronger constraint on the innovation incentives generated by VAT reform, resulting in the innovation incentives for enterprises in the top 5% are significantly smaller than incentives for enterprises in the middle 90%. For enterprises in the 5% bottom, there is no concern of diseconomies of scale. However, compared with big enterprises, small enterprises are under stronger budget constraint and face much more difficulties to attract external funds. Without sufficient own funds, these enterprises are not able to increase investment in innovation. Then the impact of VAT reform on innovation would be out of the question. Therefore, the impact of VAT reform on innovation of enterprises in the 5% bottom is significantly smaller than not only enterprises in the middle 90% and also enterprises in the top 5%.

Table 7: The impact of China's VAT reform on innovation of enterprises with heterogenous scales

	Sufficient fund	Insufficient fund	Sufficient fund	Insufficient fund
	(1)	(2)	(3)	(4)
	Innovation	*Innovation*	*Innovation*	*Innovation*
Treat*Time *size1	0.0156	-0.0665*		
	(0.0282)	(0.0394)		
Size1	0.0232**	-0.0349		
	(0.0107)	(0.0219)		
Treat*Time *size2			-0.0112	-0.0951**
			(0.0176)	(0.0397)
Size2			0.0272***	0.0122
			(0.0091)	(0.0268)
Treat*Time	0.0205*	0.0037	0.0238*	0.0095
	(0.0123)	(0.0336)	(0.0126)	(0.0341)
Time	-0.0463**	0.0266	-0.0437*	0.0217
	(0.0235)	(0.0921)	(0.0239)	(0.0928)
Treat	0.0043	-0.0079	0.0041	-0.0068
	(0.0266)	(0.0283)	(0.0264)	(0.0275)
Lcaptial	0.0079	0.0185**	0.0086*	0.0185**
	(0.0053)	(0.0085)	(0.0052)	(0.0090)
Loperation	-0.0270***	-0.0011	-0.0294***	-0.0039
	(0.0039)	(0.0041)	(0.0043)	(0.0049)
Lev	-0.0024	0.0133	-0.0007	0.0145
	(0.0215)	(0.0265)	(0.0215)	(0.0267)
Hasset	-0.0606**	0.0179	-0.0616**	0.0218
	(0.0259)	(0.0429)	(0.0260)	(0.0428)
PPE	0.0067	-0.0480	0.0042	-0.0452
	(0.0214)	(0.0404)	(0.0214)	(0.0404)
Intang	0.0519	0.0033	0.0510	0.0085
	(0.0570)	(0.0730)	(0.0568)	(0.0726)
Eqinc	-0.2247***	-0.0105	-0.2261***	-0.0172
	(0.0663)	(0.1100)	(0.0661)	(0.1103)
ROA	-0.0908***	-0.0287**	-0.0930***	-0.0325**
	(0.0188)	(0.0131)	(0.0193)	(0.0140)
Sfin	0.0010	0.0001	0.0010	0.0001
	(0.0007)	(0.0009)	(0.0007)	(0.0010)
Q-value	-0.0035	-0.0048	-0.0036	-0.0050
	(0.0029)	(0.0053)	(0.0029)	(0.0053)
Loss	-0.0016	0.0098	-0.0013	0.0083
	(0.0102)	(0.0150)	(0.0102)	(0.0150)
Cons	0.0000	-0.3091	0.0000	-0.2513
	(0.0000)	(0.2158)	(0.0000)	(0.2291)
Time fixed effects	Yes	Yes	Yes	Yes

District fixed effects		Yes	Yes	Yes	Yes
Industry fixed effects		Yes	Yes	Yes	Yes
District*time*industry		Yes	Yes	Yes	Yes
R^2		0.274	0.270	0.275	0.266
N		4864	502	4864	502

3. The impact of China's VAT reform on innovation of enterprises with heterogenous levels of technology

In order to encourage the rapid development of high-tech industries, the Chinese government has identified high-tech enterprises since 1991 in China. Ones which have been certified by the government as high-tech enterprises could benefit from a series of preferential policies covering finance, taxation, and trade. Compared with high-tech enterprises, those non-high-tech enterprises obtain much less favorable offers. Naturally, it is generally accepted that high-tech enterprises are more capable and motivated to participate in innovation activities than non-high-tech enterprises. Although China's VAT reform has the inherent qualities of stimulating innovation, it is still necessary to further clarify the impact of the reform on the innovation activities of enterprises which are at different levels of technology development.

In view of this, this paper examines the impact of China's VAT reform on enterprise innovation with another heterogeneity in enterprises' characteristics whether the enterprise is a high-tech enterprise or not. As shown in the columns (1) and (2) in Table 7, the proxy variable of the high-tech enterprise is Technology, which equals 1 if the enterprise is high-tech enterprise and 0 otherwise. The result shows that if the enterprise has sufficient own capital, the impact of the VAT reform on high-tech enterprises' motivation for innovation is significantly larger than that of the non-high-tech enterprises. However, if the enterprise's own capital is insufficient, this impact of VAT reform on the innovation of high-tech enterprises is significantly smaller than that on enterprises without high technologies. The explanation is that the innovation activities of high-tech enterprises are more constrained by funds compared with non-high-tech enterprises, and therefore, high-tech enterprises' demand for capital investment is larger. China's VAT reform increases the tax rate, however, it increases the input tax credit of enterprises. The high investment of high-tech enterprises contributes to the increased tax credit and high tax increases the responsibility of the government to share the risks (Feng and Liu, 2017). Therefore, if the enterprise has sufficient own capital, the impact of the VAT reform on high-tech enterprises' motivation for innovation is significantly larger than that on the non-high-tech enterprises. If the enterprise's own capital is insufficient, the innovation ability of high-tech enterprises is much more seriously restrained compared to non-high-tech enterprises. For the high-tech enterprises, insufficient fund fails to satisfy the high demand of investment for innovation activities, which on the one hand limits the innovation activities and, on the other hand, reduces the VAT input tax credit such that enterprises would take more risks of innovation. For the

non-high-tech enterprises, the demand for the funds for innovation activities is relatively less. Therefore, being lack of funds has a smaller negative effect on innovation activities of non-high-tech enterprises. Conclusively, if the enterprise's own capital is insufficient, China's VAT reform has a much smaller impact on the innovation incentives for high-tech enterprises.

Table 8: The impact of China's VAT reform on innovation of enterprises with heterogenous levels of technology

Variable	Sufficient fund	Insufficient fund
	(1)	(2)
Treat*Time *Tech	0.0975***	-0.0897**
	(0.0218)	(0.0383)
Technology	0.0021	0.0054
	(0.0106)	(0.0241)
Treat*Time	0.0086	0.0081
	(0.0123)	(0.0339)
Time	-0.0386	0.0226
	(0.0239)	(0.0923)
Treat	0.0046	-0.0067
	(0.0268)	(0.0279)
Lcaptial	0.0087*	0.0181**
	(0.0052)	(0.0089)
Loperation	-0.0253***	-0.0026
	(0.0038)	(0.0043)
Lev	-0.0050	0.0138
	(0.0214)	(0.0263)
Hasset	-0.0530**	0.0200
	(0.0255)	(0.0430)
PPE	0.0088	-0.0464
	(0.0214)	(0.0411)
Intang	0.0507	0.0063
	(0.0570)	(0.0727)
Eqinc	-0.2183***	-0.0120
	(0.0655)	(0.1131)
ROA	-0.0876***	-0.0302**
	(0.0184)	(0.0131)
Sfin	0.0010	0.0001
	(0.0007)	(0.0010)
Q-value	-0.0030	-0.0048
	(0.0029)	(0.0053)
Loss	-0.0024	0.0088
	(0.0101)	(0.0151)
Cons	0.0000	0.0000
	(0.0000)	(0.0000)

Time fixed effects	Yes	Yes
District fixed effects	Yes	Yes
Industry fixed effects	Yes	Yes
District*time*industry	Yes	Yes
R^2	0.2836	0.2675
N	4864	502

VI.   Conclusions and policy implication

This paper analyses the impacts of China's VAT reform on the tax burden and innovation activities of enterprises using the data of listed enterprises for the period 2004 – 2016. Our analysis obtains the following main results:

(1) China's VAT reform generally reduced the tax burden of enterprises, but the impacts on the manufacturing and on the service industry are different. The tax burden of the manufacturing reduced significantly whereas the reduction effect on the service industry is insignificant.

(2) China's VAT reform had also a significant positive impact on corporate innovation for both the service industry and the manufacturing, but these effects were significantly greater on the manufacturing.

(3) China's VAT reform did not alleviate the tax burden of all the enterprises. For the enterprises facing an increased burden of tax, the reform can still stimulate the enterprise innovation if it has sufficient own capital, whereas the impact coefficient and significant level reduced significantly compared with the enterprises that the burden of tax reduced. If the enterprise's own capital is insufficient, VAT reform has little effect on enterprise innovation.

(4) Under the condition that the enterprise has sufficient own capital, there was no significant difference in the impacts of the VAT reform on different scale enterprises' motivation for innovation. However, under the condition that the enterprise's own capital is insufficient, this impact on enterprises in the bottom 5% of firm scale is significantly less than the impact on those in the middle 90% of firm scale, and also less than the impact on the enterprises in the top 5%.

(5) Under the condition that the enterprise has sufficient own capital, compared with the enterprises without high technologies, the impact of the VAT reform on high-tech enterprises' motivation for innovation is significantly larger. However, under the condition that the enterprise's own capital is insufficient, this impact of VAT is significantly smaller on high-tech firms.

Our results underscore the impact of China's VAT reform on corporate innovation is the result of the combination of tax cuts and endogenous incentives. On the one hand, China's VAT reform generally reduced the tax burden of enterprises and then enhanced their innovation capacity. On the other hand, it changed the incentive system, providing enterprises with motivations for innovation. Therefore, it is necessary to continue to improve the current VAT system after the completion of the comprehensive experiments of China's VAT reform. From a broader perspective, the government

should actively promote tax and fee cuts, in order to stimulate further innovation. Currently, VAT accounts for more than 40% of China's total tax revenue. In such a context, VAT is without any doubt the key point of tax cuts to reduce the tax burden of enterprises by reducing the tax category and lowering the tax rate. Our results also highlight that China's VAT reform reduced the tax burden of the manufacturing significantly, but the reduction effect on the service industry was insignificant. The main explanation is that VAT reform alleviated the tax burden of some service industries, whereas increased the burden of service industries characterized as an asset-light model. Therefore, in addition to the manufacturing and transportation industries, VAT cuts should also pay attention to the service industry, especially the asset-light one, in order to improve the impact of VAT cuts on innovation.

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